

most peculiar coincidences :—(1) Renewal of eruption of Mont Pelée on morning of May 28 ; peculiar atmospheric disturbance at the Cape, simultaneous with earthquake shock there. (2) Renewal of irregularities in pressure curve on May 29 and 31 and early morning of June 1, there being renewed volcanic disturbances in West Indies on or about these same dates. The curve for these last two days is remarkable, resembling closely a series of ripples and suggesting “interference” effects.

Which was cause and which effect, or is there any correlation whatever ?

CHARLES STEWART.

Meteorological Commission, Cape Town, July 16.

A Tripartite Stroke of Lightning.

AT about 6.50 p.m. on August 7, after two or three preliminary low thunder rumblings, which by no means prepared us for what was to come, a most tremendous crash of combined thunder, lightning and electric discharge burst right over my residence here.

My butler, who was looking in the direction of our front gate, 80 yards to the north of our front door, saw a burst of smoke, mingled with a shower of leaves, rise into the air out of the adjoining shrubbery.

My coachman, who was sitting just within the open door of the lodge, close to the front gate, was dazed by a vivid burst of flame at his feet which seemed to leap into the doorway.

My neighbour's gardener, looking out of the lodge opposite, saw a nearly horizontal flash of fire enter the shrubbery close to my front gate.

A subsequent examination of the surroundings of the front gate and my coachman's lodge has revealed :—

(1) A tearing up of the ground close to the massive iron post of the front gate, the splitting of a large flint at its foot, and a litter of ivy leaves on the gravel.

(2) The clean cutting in two of an oak post, 35 yards distant to the north-east, from which an iron hand-gate was hanging.

(3) The scorching of the outside foliage of a horse-chestnut some 15 yards still further off, in a direct line with the other two objects struck.

In thirty years' experience of thunderstorms, which are rather frequent here, I have never observed the simultaneous striking of three different points by the electric discharge. A death-like stillness succeeded the crash, the storm appearing to have exhausted itself in a single tremendous explosion. Heavy rain was falling when the crash occurred. I have measured an inch and a half of rain-fall within the last three days.

Six Mile Bottom, Cambs., August 8. W. H. HALL.

Colours between Clouds at Sunset.

ABOUT sunset on the evening of Sunday, July 13, being at Ripon with my son, our attention was arrested by an unusual appearance, which I will briefly describe. Two large clouds, covering a considerable portion of the western sky, and separated by an interval leading generally towards the west, were each bordered along this interval by a bright and well-marked double spectrum. The two spectra forming this were together of the width of about one and a half times the diameter of the sun ; they followed the foldings of the edge of the clouds, and, which suggests a partial explanation, were at right angles to a fringe of nebulous striæ, which bordered the clouds, so that, except that the spectral colours were parallel instead of consecutive, the phenomenon had in some degree the appearance of the reflection from a grating.

Our observation lasted about twenty minutes, and it was especially noticeable that when, through the fading light, the more refrangible colours had disappeared, the two red lines on the rim of each cloud remained clearly marked to the last.

Never having previously seen or even heard of such an appearance, any information on the subject would be much appreciated. I might also report that on the evening of July 17 the pink streamers mentioned by some of your correspondents could be well observed, and had they been less stable, and had they radiated from the north instead of from the position of the setting sun, the appearance would have much resembled the Aurora Borealis.

JOHN BADDELEY.

Adswold, Bury New Road, Higher Broughton, Manchester.

Retention of Leaves by Deciduous Trees.

ONE of the proofs in favour of this being caused by early frost is that frequently on exposed beech and other deciduous trees only the leaves near the ground are affected and remain brown on the trees until the spring. Leaves higher up escape the frost and fall normally, as these early frosts are usually confined to the strata of air near the ground.

W. R. FISHER.

Coopers Hill, Englefield Green, Surrey, August 8.

THE WEST INDIAN ERUPTIONS.

AMONGST the last contributions to our knowledge of the eruptions which so recently devastated portions of the West Indies are five preliminary reports to the National Geographic Society. These, with excellent illustrations, appear in the July magazine of the Society.

In the following notes upon these reports attention is drawn to those portions of their contents which are not generally known, and to these are added a few observations made by witnesses, particularly those made by Captain E. W. Freeman, of the s.s. *Roddam*, whose experiences, although he was interviewed by members of the American expedition, have as yet received but slight consideration.

The first report is by Mr. Robert T. Hill, of the U.S. Geological Survey, who, with other scientific investigators, accompanied a relief expedition in the U.S. steamer *Dixie*, which sailed from Brooklyn Dock on May 14.

Notwithstanding the ill-advised introduction of matters foreign to the object of a scientific expedition, the bulk of Mr. Hill's report is well worth consideration. La Montagne Pelée, which has been introduced to our notice as the goddess of Hawaii and as the mountain which is bare or “naked,” is now referred to as the “shovelfull,” an allusion possibly to its form. In May, 1901, we are told that a picnic party discovered on its summit a small fume rising at one corner of its crater lake. On April 23 three distinct shocks were felt in St. Pierre, and everybody saw a great cloud of smoke rising from the summit crater. Two days later the lower Soufrière was in eruption, and from this date until May 5 the showers of ashes steadily increased. The succeeding sequence of events has already been published in these columns, whilst the observations of April 23 bring us nearer to the seismic disturbances of April 19, which, although they originated in Central America, there are strong reasons to suspect were the primary cause of disturbances in the Antillean fold.

As the introduction to the account of the catastrophe Mr. Hill mentions his witnesses, and here we find for the first and last time in these reports the name of Captain Freeman. Certainly there is a reference to his vessel. According to engineer Evans, of the *Roraima*, which was burned, the *Roddam* was lifted on a wave “so that her anchor chain broke and she was enabled to escape,” which is not correct. Now at the time the great and fatal blast swept across St. Pierre and its roadstead, Captain Freeman was on the deck of his vessel—then about three ships' lengths from the shore—and for some time at least could see what occurred, whilst other witnesses whose testimony is referred to had sought refuge in engine-rooms or down below. Captain Freeman says that although there were many minor puffs of clouds from Pelée there was only *one* great eruption, and this came from the side of the mountain. There were no detonations or loud reports, and from his point of view there was no sheet of flame accompanying or following the blast. The force of this, which came with the wind, was so great that he believes it was the cause of the s.s. *Grappler* turning turtle. There was no return blast, neither was there any absence of air. The difficulty in breathing was due to the quantity of fine ash with which the atmosphere was charged and the fetid gases with which it was mixed.

The *Roddam* was not saved by being lifted on a wave, neither was it saved by knocking out shackle pins and slipping the cables. What Freeman did was to free his windlass and then run full speed astern until the cable parted. After that, the steering gear being jammed with ash, he steamed ahead and then astern, close to burning ships, seeing and hearing the cries of those on board and also of those who were running to and fro along the shore. From this it is certain that many of the people in St. Pierre did not die suddenly. Twenty-six of his own men also died, and for the most part they died slowly. At the end of an hour and a half the gear was cleared and he escaped. Then came a shower, not of mud, but of rain. About eight hours later, with 120 tons of fine sand-like ash upon its deck, the *Roddam* steamed into St. Lucia. Notwithstanding the fact that possibly 2 or 3 per cent. of this material consisted of grains of magnetite, and the quantity of ash containing this material above and around his vessel was so great that daylight was replaced by a darkness that could be felt, such compasses as were left in the *Roddam* were serviceable for navigation and did not show any irregularity in behaviour. Before the eruption nothing unusual was observed in the barometer.

These few notes, which bear upon the reports we are considering, but, as will be seen, are not entirely in harmony with the same, come from a man who saw the great explosion, was in the midst of its blast and saw what could be seen from the sea of the events which closely followed its occurrence.

That Captain Freeman, whilst on a burning ship, where he was more than half suffocated with hot ashes, when the boots were burned from his feet, his face seared and his hands so scorched and welts that he worked with his elbows, had the presence of mind to do what he did and the physical and mental power to carry out his intentions under these trying conditions is one of those instances of will-power and endurance possessed by few so well worthy of record. Let it be repeated, the *Roddam* was not saved by accident, but it was saved as Captain Freeman saved it once before whilst eleven other steamers foundered, by good judgment and courage, and it is to be hoped that before long he will receive from underwriters or others substantial recognition, not only for his services on the *Roddam*, but for the example he has placed before the world.

To return to Mr. Hill's report, at 7 o'clock on the morning of May 8 Mr. Ferdinand Clerc observed the needle of a large aneroid barometer pulsating violently, and it was in consequence of this fact that he left the city and escaped. It is, of course, possible that these movements were due to the air disturbances accompanying the outbursts of "smoke" which preceded the great eruption. This eruption, which took the form of a big black cloud, no doubt made up of ash, steam and other gases, issued from "a point fully 1000 metres below the summit" and travelled at the rate of a mile a minute downwards over the surface of the earth upon St. Pierre and its harbour. The ashes which fell upon the deck of the *Roddam* were found still to be warm thirteen days after the eruption.

At the time they fell on the *Roraima* they were hot enough to ignite rope and bedding, but not to ignite wood. This statement, according to Captain Freeman, means that the level surface of a deck would not be fired by a thick layer of such ashes, whilst woodwork round the edges of such a layer might be ignited. At all events the *Roraima* and other vessels were destroyed by fire, whilst the cloud as it passed over St. Pierre set fire to buildings. The *Dominica Guardian* of June 25 writes on this subject as follows:—

"It would appear that a sudden fissure was opened on the side of the mountain overlooking the city; and, near to the Étang Sec on this flank of the volcano, a large

vent belched out lava, superheated steam and acid gases downwards on to St. Pierre and the roadstead. The flashing off into steam of the water imprisoned in the incandescent lava converted that lava into sand and dust before it reached the city, and the radiation of heat from molten rock at a temperature of more than 1000° C. caused an incredibly hot blast that would create a red hot hurricane—if I may employ such a term—that would kill people and animals instantly, and that would cause all inflammable matter to burst into flame. This from what I gather is what really happened, and I do not think that poisonous gases or electrical phenomena are accountable for the destruction of life."

The steam, hot air or gas penetrated clothing without firing the same, but it burned the skin beneath. This seems to have been true for those who were on the seaward side of St. Pierre, but it hardly appears to have been the case with those who were on the side nearest to the eruption.

Those who saw the cloud from the front, Mr. Hill tells us, say that it was not accompanied by incandescence, whilst those who were at the side or behind the same testify to seeing a flash-like flame suggestive of the ignition of a gas. It is quite conceivable that those behind the cloud might see that which was invisible to those in front, but the nuns at Morne Rouge do not appear to have seen the alleged flame.

The total quantity of ash that fell in St. Pierre was less than 1 foot in thickness, and it was piled highest against the northern walls, that is, on the side facing Mont Pelée.

In the blackening of silver and other metal objects picked up in the ruins, Mr. Hill sees evidence of the presence of vapours which were sulphurous. That silver should have been blackened within a burning house is what might be expected, but it does not follow that this blackening was due to sulphur from Mont Pelée. That there were small quantities of sulphurous vapour escaping before the great eruption is exceedingly likely, but when the latter took place it is more likely that the gas which accompanied the steam blast was hydrochloric rather than sulphurous. Since the days of Sodom and Gomorrah sulphur has been associated with volcanic action, and in the popular mind a volcano must always be accompanied by the combustion of this element.

The force of this blast may be judged by the photographs, the most striking of which is that of the monument of Our Lady of the Watch, which, although it weighed several tons, was hurled 50 feet. The blast caused vessels to turn turtle, walls were blown down and almost every standing object was levelled with the ground.

After the first blast, which pulverised buildings on the north side of St. Pierre, there was a return blast to blow over the south end of buildings, and lastly there came what appears to have been a vacuum—witnesses say that they "could get no air to breathe."

The fact that in the clouds which were thrown out in subsequent eruptions there were "tremendous displays of bolts and flashes" suggests that the flash which is said to have accompanied the primary outburst may have been a phenomenon akin to sheet lightning, which could only be seen on one side of the cloud which covered St. Pierre.

With this blast there was practically no noise of a great explosion, neither was there any evidence of marked seismic activity.

People were killed by inhaling hot ashes, some were burned by ashes or steam or flames, and by no means did all die instantly. With the exception of a few trees and plants protected in deep ravines, the country around St. Pierre was denuded of vegetation, but it is satisfactory to read that "nineteen-twentieths of the area of Martinique is as green and beautiful to-day as ever it was." Out of an area of 380 square miles only 12½

square miles have been devastated. No lava flowed, but only streams of mud, and to this it is added that neither the land nor the sea bottom has subsided or been uplifted—a statement in which we cannot concur.



[Photo by Israel C. Russell.]

FIG. 1.—Mud-plastered landscape, south end of Morne d'Orange.

Evidences of lightning strokes have been found in St. Pierre by Prof. Heilprin, but they are not numerous. The time at which the city was overwhelmed was at 7.50 a.m. (local time). At 7.53 and 7.55 magnetic disturbances commenced at Cheltenham, near Washington, and at Baldwin, in Kansas, and disturbances were also recorded in Paris and Hawaii.

In the *résumé* of the report Mr. Hill tells us that the fatal explosions were not from the old crater of Mont Pelée, which is 5 miles from St. Pierre, but from a lower vent about $2\frac{1}{2}$ miles distant, and it is therefore a Soufrière which has created destruction both in Martinique and in St. Vincent.

The report furnished by Prof. Israel C. Russell refers to both of these islands. It commences with a list of those who were fortunate in obtaining berths on board the *Dixie*, amongst whom was Mr. Borchgrevink, who conversed on "the desolate wilds of the Antarctic Con-

ejected in Martinique was much finer than that thrown out in St. Vincent, where stones 5 and 6 inches in diameter fell at a distance of about 5 miles from their origin.

Mr. J. S. Diller describes the rocks of Mont Pelée as hypersthene and hornblende hypersthene andesites. The material forming the peak of Mont Carbet is a dacite or quartz andesite. The pumice from the recent eruption is hypersthene andesite. Eight chemical analyses show differences in ejectamenta from different eruptions and in the character of the materials which fell near and at a distance from the craters from which they originated.

The lavas from St. Vincent are also hypersthene andesites, but are peculiar in the fact that they contain olivine. In the ejecta from St. Vincent sulphur, which is absent in that from Mont Pelée, is a marked constituent. In a separate report Mr. W. F. Hillebrand points out other differences between the lavas and lapilli from these two islands which are sufficiently marked that the product of Pelée can be easily distinguished from that of La Soufrière. In referring to Dr. Pollard's analyses (see



[Photo by Israel C. Russell.]

FIG. 3.—A river of mud pouring from La Soufrière.

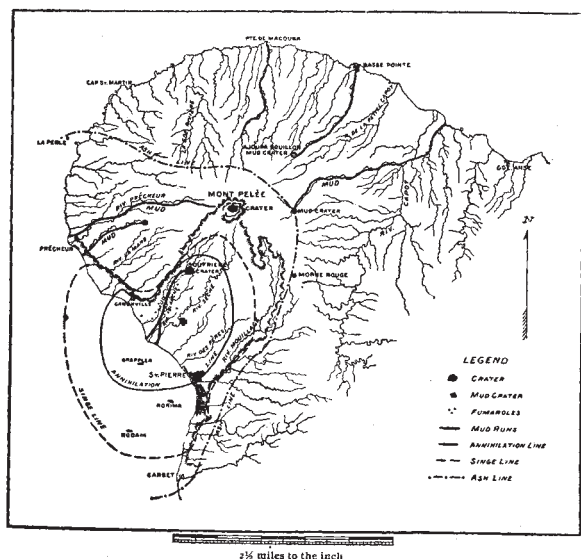


FIG. 2.—Map prepared by Mr. Robert T. Hill showing zones of devastation in Martinique.

continent," but whose report is held back for a future publication. Mr. Russell's photographs are excellent, and without these the instructiveness of his and other reports would have lost much in value. The material

NATURE, vol. lxxi. p. 130) indicating the presence of nickel and cobalt, Mr. Hillebrand remarks:—"Either we of the Survey have overlooked traces of nickel . . . or Dr. Pollard has counted as nickel something which was not that element."

Although we have here and there ventured a few critical remarks upon these reports, we cannot but regard them as a valuable contribution to vulcanology, and anticipate pleasure in the perusal of their continuation.

In the August number of the *Century Magazine* we have read with interest two articles on "The Last Days of St. Pierre," each of which is founded upon documentary evidences. The first of these is a letter written in the form of a journal by the Very Rev. G. Parel, vicar-general of Martinique, to his Bishop, and the second a series of extracts contained in *Les Colonies*, a daily paper published in St. Pierre. Although, as might be anticipated, a large portion of these documents refer to the attitude taken by the inhabitants of the stricken districts, and furnish details of local rather than of general interest, much may be extracted from them of scientific value.

Now we learn that Mont Pelée showed its cap of white vapours as early as April 25, and that excursionists who were attracted by the spectacle reported that the Étang Sec, "which has the shape of an immense basin inclined towards St. Pierre," was filling up with boiling water.

Prior to the eruption of 1852 this cirque was also filled

with water, but subsequently it dried up. Although sulphurous vapours escaped from its bed, which led to its being named La Soufrière, we read that it was more or less covered with vegetation.

On May 2, in addition to vapours, Pelée erupted ashes to cover Le Prêcheur. At 11.30 that night there were terrifying detonations, and "cinders" covered the country as far as Fort de France. These detonations, but varying in intensity, were continuous. With these sounds were mixed those of thunder, which followed the flashes of lightning in the dust cloud, the general rumbling in the crater, and the roar of many torrents. Thirty streams round Mont Pelée rose at once, and yet not a drop of rain had fallen on the coast. On May 5 the Rivière Blanche became a threatening and muddy torrent. Suddenly a column of vapour was seen to rise from the valley that expands below the crater of Mont Pelée, following which a "boiling water-spout" burst in the mountain, and this, laden with rocks and earth, buried the Guérin Sugar Works and rushed seawards, to founder two yachts, one of which was 150 metres off the shore, and to sink eight lighters.

Near the site of the factory this mud is at least 6 metres in depth. It appeared to Prof. Landes, who contributed to the last issue of *Les Colonies*, that the contents of the Étang Sec had broken their barrier and avalanche-like had rolled 700 metres downwards to the sea. The origin of this disaster, like that which on May 8 destroyed St. Pierre, is therefore to be found on the flanks of Pelée rather than at its crater.

Those who on April 27 visited the Étang Sec describe the same as a bowl 300 metres in diameter at the bottom and 800 metres at the top. The surface of the lake within this bowl was covered with black cinders, whilst the trees round the crater were covered with a "metallic black coating."

On the eastern side of the basin there was a cone 10 metres high and about 15 metres in diameter at its summit. From this new crater "smoke" rose in great puffs, water spouted from the borders of the basin and poured downwards to the lake, and there was a sound of boiling. The temperature of the water in the lake was that of the body, but where it entered it was probably very much higher. It deposited a fine slate-coloured powder, and contained sulphurous gas which blackened silver. Here and there green leaves could be seen in the lake, which the guides affirmed were on the upper branches of trees probably 20 metres in height.

The vicar-general says that about 4 a.m. on May 7 he saw on the flanks of Pelée two red craters, and these were visible for half an hour. On May 8, about 4 a.m., there was a violent thunderstorm, and torrents of rain fell in Fort de France.

At about 8 o'clock there was a hail of stones and hot cinders, and the sea retreated three times a distance of several hundred metres. Whilst this fiery tornado was obliterating St. Pierre, two atmospheric currents—one from the south-east and the other from the north—showered rain upon its flanks.

On May 1 *Les Colonies* told its readers that on April 29, between 3 and 5 p.m., there had been several shocks of earthquakes, but nothing is said about volcanic eruptions.

On May 2 it advertises an excursion to Mont Pelée, but it is not until after the eruption which took place the same night that any serious reference is made to the volcano. Next day (Saturday, May 3) *Les Colonies* is filled with details relating to a cinder rain that never ceases, the closing of houses, the difficulty of obtaining vegetables, the obliteration of roads, the muddy rivers, the dead birds and dying animals, and the flight on the steamers of the Compagnie Girard.

Great fear seems to have existed lest an earthquake should occur. The issues of May 6 and 7 continue the

gruesome story. In his last issue the editor inserts a note that Thursday, May 8, being the Feast of the Ascension, his offices would be closed, and the next number of *Les Colonies* would appear on Friday. But for St. Pierre Friday never came.

A second paper in the *Century Magazine* gives the narratives of two eye-witnesses of the eruption in St. Vincent. The first of these is from Captain Calder, chief of the police in that island. From his account it appears that La Soufrière showed signs of eruption on May 5. On May 6, at 8.30 p.m., Captain Calder left Kingstown by boat for Chateau Belair, and about midnight he saw the whole top of the mountain burst into "flame." This was followed by a heavy explosion.

At 2.30 a.m. (May 7) there were similar explosions, with but little "flame." About 10 a.m. there was a terrific explosion, and in the "smoke" cloud there was a little pale flame. At 1.30 p.m. this cloud had reached a height of at least two miles. Next he describes the flight of the population holding boards above their heads to prevent injury from falling stones, following which are detailed accounts of the varying phases of the volcanic activity and the destruction which it wrought.

The second personal narrative is from Mr. T. McGregor McDonald. From this it appears that at Chateau Belair the first notice of an eruption was at 2.40 p.m. on May 6. At first the Soufrière erupted columns of white vapour without explosions. At 7.30 p.m. the vapour was accompanied with flame, and explosions took place at intervals of about two hours.

On May 7, at 6 a.m., black "stuff" was erupted. About 7.45 columns of vapour rose to a height of 30,000 feet in one minute. From 11.10, when there were thunder and lightning, Mr. McDonald made entries in his notebook of what was occurring almost every five minutes. This he did until 2 p.m., when beneath a rain of stones he escaped to Walliabout, where the diary was recommenced and continued up to 9.30 p.m. on May 14.

J. MILNE.

A TEXT-BOOK OF MAMMALS.¹

FEW branches of zoological science have made greater advances during the last ten or a dozen years than has the study of mammals. Investigations with the microscope and the section-cutter have revolutionised our ideas as to the homology and succession of the dentition of the marsupials, while our conception of the relationship of that group to the monotremes on the one hand, and to the typical placentals on the other, has been totally altered by the discovery of a vestigial placenta in the bandicoots, and also by the apparent evidence of a connection with the creodonts afforded by certain extinct types from the South American Tertiaries. Then, again, the systematic part of the subject has been enriched by the discovery of a number of totally new and unexpected living generic types, such as *Notoryctes* and *Cænolestes* among the marsupials, *Zenkerella* and *Idiurus* among the scaly-tailed African squirrels, and *Ocapia* among the ungulates. Our conceptions of species and local races have undergone an equally profound change in the group under consideration, and the number of such new forms—some good and some bad—which have been added to our lists during the last few years is little short of astonishing. Moreover, trinomialism has been introduced into the science, and is largely adopted by a considerable number of eminent writers; and nomenclature itself has undergone a change which, while in many respects regrettable, could scarcely have been avoided, at least to a certain degree, if zoology is to maintain any

¹ "The Cambridge Natural History." Vol. x. Mammalia. By F. F. Beddard. Pp. xii+605. Illustrated. (London: Macmillan and Co., Ltd., 1902.) Price 17s. net.